Marginal lands for Growing Industrial Crops

Deliverable reference number and title:

D8.10 – List with the practice abstracts following the EIP common format (version 1)

Due date of deliverable: M18

Actual submission date: 21-02-2019

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Type

R	Document, report	☒
DEM	Demonstrator, pilot, prototype	☐
DEC	Websites, patent fillings, videos, etc.	☐
OTHER		☐

Dissemination Level

PU	Public	☒
CO	Confidential, only for members of the consortium (including the Commission Services)	☐

Horizon 2020
European Union Funding
for Research & Innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement No. 727698.

Table of contents

List of figures

List of tables

Abbreviations

COGECA: General Confederation of Agricultural Cooperatives
COPA: Committee of Professional Agricultural Organisations
EIP-AGRI: European Innovation Partnership for Agricultural productivity and Sustainability
DBH: Diameter at Breast Height
DSS: Decision Support System
EC: European Commission
ET: Evapotranspiration
EU: European Union
GCV: Gross Calorific Value
GHG: Greenhouse Gas
JRC: Joint Research Centre
MAGIC: Marginal lands for Growing Industrial Crops
P: Precipitation
PA: Practice Abstract
REA: Research Executive Agency
SRC: Short Rotation Coppices

Partners short names

CIEMAT: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CRES: Centre for Renewable Energy Sources and Saving
IBCSB NAASU: Institute of Bioenergy Crops and Sugar Beet National Academy of Agrarian Sciences of Ukraine
Imperial: Imperial College of Science Technology and Medicine
nova: nova-Institut für Politische und Ökologische Innovation GmbH
Spanish Co-ops: Cooperativas Agro-alimentarias de España
UHOH: Universität Hohenheim
UNICT: Università Degli Studi di Catania
WR: Stichting Wageningen Research
3B: BioWarmia Bioenergy and Bioresources Michal Krzyzaniak

1 Executive summary

One of the MAGIC Project targets is "to maximise stakeholder' mobilization and enhance the impact of the project activities and outcomes for promoting the cultivation of industrial crops on marginal land". In this line, practice abstracts (PA's) are short summaries that describe main information that can serve end users in their daily practice. Following the guidelines of the EIP-AGRI and their common format, MAGIC will produce as many PA's as required for dissemination over the entire duration of the project. PA's will feed the newsletter and webpage of EIP-AGRI with easily understandable practical knowledge that is expected to reach a broader public.

This document presents fiteen preliminary practice abstracts that introduce the potential or expected results at the end of the project. This report is a living document which will be updated as project progresses and results are available.

2 Introduction

The European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) was launched by the European Commission in 2012. This initiative aimed to help all EU countries to provide their citizens with a more competitive economy, better jobs and life standards, fostering a competitive and sustainable agriculture and forestry sector that "achieves more from less".

The EIP-Agri adheres to the "interactive innovation model" which brings together specific actors (e.g., farmers, advisors, researchers, businesses, etc.) to work together in multi-actor projects to find a solution for a specific issue or developing a concrete opportunity. In this sense, communicating about projects activities and results is much easier through the use of a common format (see *Figure 1*). Such common format facilitates the knowledge flow and enables contacting of farmers, researchers and all the other actors involved in innovation projects. The EIP common format consists of a set of basic elements characterising the project, including practice abstracts (PA's). The format is developed with the aim of enable contacting partners and incentivise efficient knowledge exchange and to disseminate the results of the project in a concise and easy understandable way to practitioners.

All the PA's generated during the period of the MAGIC project will be uploaded to the EIP-AGRI website, where the information will be shared at EU level, via the EIP- AGRI project database, a unique repository which supports the dissemination of results of all interactive innovation projects. In addition, these PA's will be a useful dissemination tool to share the updates and outcomes of MAGIC both with the EIP-AGRI subgroup of innovation and the COPA-COGECA Sectoral Boards of European farmers.

This document presents fifteen preliminaries PA's that have been developed based on the deliverables submitted so far and the outcomes provided by the long-term field trials. Even though not so many results are available at this time, the following PA's intended to present preliminary and potential results and provide an overview of the expected benefits for practitioners. As the project progresses, more PA's will be released based on other public deliverables, long-term field trials or any other useful outcomes.

3 Methodology

Practice abstracts (PA's) are short summaries of around 1000 - 1500 characters (word count – no spaces) which describe main information/recommendations and serve end users in their daily practice. All PA's have been prepared following the guidance and Common Format of EIP-AGRI (see *Figure 1*) in the shape of an excel template. The information shown in this template (see Annex B) is accumulative and will be updated when new practice abstracts are available. Every PA must be accompanied by a short title of no more than 150 characters.

Summaries (see *Figure 2*) are expected to contain the following information:

- Main results/outcomes of the activity (expected or final).
- Main practical recommendations such as the main added value/benefit/opportunities to the end user.
- How the generated knowledge is implemented and how the practitioner can make use of the project results.

Both the summary and the title may be also provided in the native language of the coordinator or one of the partners. However, an English version of PA's must always be available. In addition to the PA's, the excel template contains some general information about the project, including keywords, list of partners and contacts, website and audio-visual material (see Annex B).

Finally, the PA is delivered to agri-eip-practice-abstracts@ec.europa.eu with copy to the Project Officer (REA) and Policy Officer (DG AGRI).

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT

Directorate H. Sustainability and Quality of Agriculture and Rural Development
H.5. Research and Innovation

EIP-AGRI Common format for interactive innovation projects

The interactive innovation approach under the European Innovation Partnership Agricultural Productivity and Sustainability (EIP-AGRI)[1] fosters the development of demand-driven innovation, turning creative new ideas into practical applications thanks to interactions between partners, the sharing of knowledge and effective intermediation and dissemination.

The EIP **common format** consists of a set of basic elements characterising the project and **includes one (or more) "practice abstract"(s)**. The format was developed with two main objectives:
(1) to enable contacting partners and incentivise efficient knowledge exchange, and
(2) to disseminate the results of the project in a concise and easy understandable way to practitioners.
The common format allows providing information all along the life-cycle of the project. The **content of the common format can be updated at any moment** when useful, for instance in an intermediate phase of the project. Project information should at least be available at the beginning (describing the situation at the start of the project, including project title and objectives) and at the end of the project (describing the results/recommendations resulting from the project, including a final project report and one or more practice abstracts).

EIP-AGRI Common format | INSTRUCTIONS | PROJECT INFORMATION | PARTNERS | KEYWORDS | AUD

Figure 1. EIP-AGRI Common format.

A	B	C	D	E	G	H	I
Practice "abstract" 1:	Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.						
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: - Main **results/outcomes** of the activity (expected or final) - The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.		Recommended	0 character(s) / 1500				
Short summary for practitioners in native language		Mandatory	0 character(s) / 1500				

EIP-AGRI Common format | INSTRUCTIONS | PROJECT INFORMATION | PARTNERS | KEYWORDS | AUDIOVISUAL MATERIAL | WEBSITES | PA1 | PA2

Figure 2. EIP-AGRI template for PA.

4 Practice abstracts

4.1 PA1: About MAGIC Project

Title: Marginal lands for growing industrial crops

Summary: Marginal lands for Growing Industrial Crops (MAGIC) is a 4-year project and gets funding by the European Commission. The project aims to promote the sustainable development of resource-efficient and economically profitable industrial crops grown on marginal lands.

Industrial crops can provide abundant renewable biomass feedstocks for the production of high added-value bio-based commodities (such as bio-plastics, bio-lubricants, bio-chemicals, pharmaceuticals, bio-composites, etc.) and bioenergy. Most of these crops are multi-purpose and offer the opportunity to follow a cascade biorefinery concept to produce a number of high-quality bio-products and bioenergy, to strengthen the bio-based economy.

To achieve the project objectives, an up-to-date database of existing resource-efficient industrial crops will be developed with information on their agronomic characteristics, input requirements, yield performance and quality traits for end use applications. In parallel, current and future marginal lands in Europe facing natural constraints will be mapped, characterised and analysed to provide a spatially explicit classification that will serve as a basis for developing sustainable best-practice options for industrial crops. A Decision Support System (DSS) based on both MAGIC-CROPS and MAGIC-MAPS will be developed and validated with the active involvement of farmers and end users in order to choose the most promising industrial crop at any geo-location in Europe.

In the long term, this strategy will foster the sustainable development of the EU bio-based economy and will contribute to achieving EU energy and climate targets.

4.2 PA2: About spatially explicit map database of MAGIC

Title: Mapping marginal lands for growing industrial crops

Summary: The purpose of the MAGIC mapping is to characterize and analyse projections for current and future marginal lands in Europe facing natural constraints.

Identified MAGIC marginal lands are defined as: "Lands having limitations which in aggregate are severe for sustained application of a given use and/or are sensitive to land degradation, as a result of inappropriate human use, and/or have lost already part or all of their productive capacity as a result of inappropriate human use". The elements that were considered in building the classification include biophysical limitations clustered in six main groups. In addition, the resulting marginal land map was further classified according to, land use management, socio-economic limitations, ecosystem services and drives and pressures influencing the ecosystem functions.

As a result, in total 29% of the agricultural land (i.e. land classified as agricultural by Corine Land Cover since 1992) in the European Union are classified as marginal. The most common limitations are rooting limitations, with 12% of the agricultural area. This is followed by adverse climate and excessive soil moisture occurring in respectively 11% and 8% of the agricultural land.

The spatial explicit classification created by MAGIC will serve as a basis for developing sustainable best-practice options for industrial crops in Europe. In addition, the spatially explicit map database is accessible via the project website and will be maintained and further improved during the project's lifetime and at least five years beyond the project completion. Visitors to the public website can access the map to inform themselves about the marginal land status in their region but can also help to evaluate the quality of the map.

4.3 PA3: About MAGIC long-term field trials

Title: Long-term field trials with industrial crops on marginal land

Summary: One of the expected results of the MAGIC Project will be a comprehensive overview of the long-term performance potential of industrial crop cultivation on marginal land in Europe. For this purpose, the results of several long-term field trials with important industrial plants such as Miscanthus, Giant Reed, Reed Canary Grass, Camelina, Hemp and Poplar, which are carried out Europe-wide under the most important marginal growth conditions such as adverse rooting conditions, adverse climatic conditions and unfavourable terrain, will be compiled and evaluated. Many of these field trials are still on-going. In particular, the best low-input agricultural cultivation strategies for the crop categories 'tillage', 'nitrogen fertilization', 'weed control' and 'irrigation' will be identified.

Practitioners should benefit from the results by implementing low-input agricultural practices for industrial crop cultivation, which are adapted to both the marginality conditions of their locations and to the market requirements in their region. It is assumed that this will increase both the overall income of the farms and the net profit due to higher biomass yields (and qualities) and higher production efficiencies. In addition, to these direct benefits, it is expected to bring indirect benefits through improved legal frameworks resulting from the policy recommendations.

4.4 PA4: About Miscanthus long-term field trial in Germany

Title: Miscanthus cultivation on marginal land in southwest Germany

Summary: In 2012 and 2014, several field trials with Miscanthus (a perennial C4 grass for combustion and other conversion routes) were carried out at various marginal sites in southwest Germany. The most severe marginality conditions at one of these sites ('OLI') are a combination of adverse root conditions (shallow soil (10 - 20 cm) and stoniness (50%)) and low temperatures (frost and short vegetation period). At OLI, six genotypes of Miscanthus were established in 2014 (~1 plantlet/m²). Weeding was performed by hand in 2014 and 2015. The harvest was carried out each year in spring starting from 2016. No fertilization was applied. The previous crop was grassland. The estimated accumulated dry matter yields of the first three growing seasons (2015, 2016 and 2017) range between 12.4 t/ha (GNT 4) and 30.9 t/ha (*Miscanthus* × *giganteus*). These preliminary results suggest that low-input cultivation of Miscanthus on shallow stony soil under low temperature conditions may be a success depending on the genotype. *Miscanthus* × *giganteus* is expected to provide high dry matter yields (in relation to the given marginal growing conditions) also in the following seasons.

The expected main recommendation of these results is that farmers should consider the possibility of growing *Miscanthus* × *giganteus* on marginal areas similar to those of OLI (shallow stony soil + low temperature). In addition to economic benefits such as high biomass yields, low external inputs (fertilizers, pesticides) and low labour intensities (except for the establishment procedure), there are a number of eco-systemic advantages of *Miscanthus* × *giganteus* over annual cultivation systems such as improved soil fertility, habitat networking and reduced soil erosion.

4.5 PA5: About Miscanthus and Energy Willow long-term field trials in Ukraine

Title: Ukrainian practice of growing Miscanthus and Energy Willow on marginal land

Summary: Soils studied at the Ukrainian case present two main marginality factors; unfavourable soil structure (hard clay) and poor chemical properties (acidity, low organic matter).

Growing Willow on a hard clay soil (≥50% clay) can result in good productivity, however, it requires additional agronomical practices. Thus, ripping of interspace improves agro-physical properties of the soil while the treatment of cuttings with humic products and micronutrients facilitates their rooting and adaptation to the specific conditions of growing. Application of mineral fertilizers is not necessary on such soils, as their natural productivity in Ukraine is rather high. Growing Willow on hard clay soils without plant adaptation measures leads to a small annual height increment and low productivity of plantation. Energy Willow produces large volumes of dry biomass starting from the 3rd year of growing. When harvested every two years, willow reveals its full potential on the 4th year of growing.

When growing Miscanthus on acid soils, minimum amount of nutrients is required, for example, neutral mineral fertilizers N40P40K40. The maximum plantation productivity may be gained on the 4th year of growing.

Productivity of energy crops for growing on soils with low content of organic matter largely depends on the type and amount of fertilizers applied. Therefore, fertilization must be performed considering the actual nutrients removal with harvest. Growing Miscanthus in this kind of soils during seven years allows to increase organic matter content in ploughed soil layer by 0.37%.

Planting depth (8, 12 and 16 cm) had insignificant effect on increasing winter hardness of Miscanthus and its green and dry biomass yield on the 2nd and 3rd years of growing.

4.6 PA6: About Wild Sugar Cane long-term field trial in Italy

Title: Wild Sugar Cane on marginal lands affected by drought in southern Italy

Summary: Mediterranean climates are characterized by long periods of drought during summer and short dry periods from autumn to spring, what limits plant CO_2 assimilation and biomass production to a great extent. More limiting scenarios are forecasted due to climate change in the coming years in the Mediterranean basin. Under these circumstances, plants with excellent adaptation are needed. Perennial crops, and grasses in particular, have proved to be more efficient than annual crops for biomass production for several environmental and economic reasons. The Joint Research Centre (JRC) has set thresholds to define marginal lands in terms of biophysical constraints. In this case, climate limitation given by the ratio between precipitations and potential evapotranspiration (P/ET) was focused. Areas with P/ET ≤0.60 are classified as affected by dryness. The study follows up a long-term plantation of the C4 perennial grass wild sugarcane (*Saccharum spontaneum* ssp. *aegypticum*) under different water regimes in a semi-arid environment. The species were established at the experimental farm of the University of Catania in 2005 by using rhizome cuttings. Biomass dry matter yield was significantly affected by irrigation treatment and meteorological conditions of the growing season (mainly precipitation amount and distribution) with yield values ranging between 29.9 and 37.1 Mg ha^{-1} in full-irrigation, between 24.5 and 32.0 Mg ha^{-1} in half-irrigation and between 19.1 and 27.4 Mg ha^{-1} in rainfed conditions. Wild Sugar Cane is well adapted to environments dominated by dryness, and even after 10 years the biomass yield remain quite stable and at very high levels. However, agronomic, energetic, environmental and economic issues need further research.

4.7 PA7: About Arundo and Miscanthus long-term field trials in Italy

Title: Arundo and Miscanthus on marginal land affected by dryness in fertilized and unfertilized conditions in southern Italy

Summary: Perennial, non-food grasses have been proposed as the most efficient species for biomass production due to their agronomic, environmental and social benefits. Species characterized by high water use efficiency and low nitrogen requirement, well adapted to use natural resources of a specific environment, can be recommended as ideal crops. Along with irrigation and water savings, nitrogen requirement is a significant issue in intensive agriculture and has a great effect over the energetic balance of crops. Therefore, low input cropping systems could directly mitigate greenhouse gas emissions. In this case long-term plantations of two perennial grasses (*Arundo donax* and *Miscanthus x giganteus*), grown in rainfed conditions under two nitrogen regimes, were compared in an environment affected by dryness (according to the thresholds set by the Joint Research Centre (JRC) in terms of ratio between precipitations and potential evapotranspiration ($P/ET \leq 0.60$)). *Miscanthus x giganteus* and *Arundo donax* were transplanted in summer 1993 and in spring 1997, respectively. In 2015 (22-year for Miscanthus and 18-year for Arundo), Arundo and Miscanthus (fertilized with 80 kg N ha^{-1}) showed similar yields (11.9 and 10.4 Mg DM ha^{-1}), while Arundo unfertilized (N0) produced 10 Mg DM ha^{-1} against 5.3 Mg DM ha^{-1} of Miscanthus N0. In 2016 (23-year for Miscanthus and 19-year for Arundo) Arundo and Miscanthus N0 produced 10.6 and 6.2 Mg DM ha^{-1}, while Arundo and Miscanthus N80 attained 15.3 and 8.7 Mg DM ha^{-1}. In 2017 (24-year for Miscanthus and 20-year for Arundo) a similar trend was observed, Arundo N80 showed the highest yield (14.9 Mg DM ha^{-1}) followed by Miscanthus N80 (9.7 Mg DM ha^{-1}), Arundo N0 (8.4 Mg DM ha^{-1}) and Miscanthus N0 (5.9 Mg DM ha^{-1}).

4.8 PA8: About Siberian Elm long-term field trial in Spain

Title: Siberian Elm long-term field trial in Spain

Summary: Siberian Elm (*Ulmus pumila* L.) is a hardy and fast-growing tree that features greater resistance to Dutch Elm disease than other species in genus *Ulmus*. Drought tolerance, adaptation to different environments and sprouting capacity suggest that this plant species could be grown as a short rotation energy/industrial crop.

Siberian Elm was planted in 2 plots in 2009 and 2010 in marginal land in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2009, two plant densities (3,333 and 6,666 plants ha^{-1}) under two irrigation regimes (2,000 and 4,000 m^3 ha^{-1} y^{-1}) were implemented and one plant density was established in rainfed conditions in 2010. Furthermore, 2 crops cycles were studied in each plot.

The results for a nine years period confirmed that Siberian Elm is a fast-growing woody species, adapted to the harsh climate of Soria: cold winters, frosts, and wind. It is also resistant to pests and diseases since no pesticide treatment has been carried out.

Siberian Elm prefers well-drained soils, although it also tolerates a wide variety of adverse conditions, such as soils with low organic matter content and flooding situations.

Yield was strongly influenced by the amount of irrigation water applied, planting densities and crop cycle. Maximum yields were obtained with planting densities of 6,666 and 3,333 trees/ha cropped every 3 and 4 years, respectively. The yield ranged between 4 - 7.5 t.d.m. ha^{-1} y^{-1}.

The composition of the biomass was: ash content 3.0%, 48.0% C, 6.0% H, 0.5% N and Gross Calorific Value (GCV) of 19.2 $MJ.kg^{-1}$.

4.9 PA9: About Tall Wheatgrass long-term field trial in Spain

Title: Tall Wheatgrass long-term field trial in Spain

Summary: Perennial grasses have been envisaged by the scientific community as an interesting group of plant species for the sustainable production of biomass in marginal land in terms of crop diversification, improved control of soil erosion and recovery of soil organic matter content. Compared with annual grain crops, perennial biomass crops require fewer inputs, produce more energy and reduce Greenhouse Gas (GHG) emissions than annual cropping systems.

In 2010 and 2013, field trials with Tall Wheatgrass were carried out in two marginal lands in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2010 *Elytrigia elongata* Alkar was studied as single crop and mixed with other annual and perennial species. In 2013 three *Elytrigia elongata* cultivars: Alkar, Szarvasi-1 and Bamar were established on a parcel.

The results obtained in an eight years period showed that Tall Wheatgrass is a species well adapted to the hard climate conditions of Soria with a high tolerance to drought. Moreover, it is a crop resistant to pests and diseases since no pesticide treatment has been carried out.

Tall Wheatgrass prefers well-drained soils, although it tolerates a wide variety of adverse conditions, such as soils with low organic matter content and moderate salinity. However, flooding situations should be avoided.

Yields were between 2 and 5 t.d.m. ha^{-1} y^{-1}. *Elytrigia elongata* Alkar produced the most yield when planted as single crop. *Elytrigia elongata* Szarvasi-1 produced the most yield.

The composition of the biomass was: ash content 5.2%, 46.0% C, 6.1% H, 0.6% N and Gross Calorific Value (GCV) of 18.5 $MJ.kg^{-1}$.

4.10 PA10: About Switchgrass long-term field trial in Spain

Title: Switchgrass long-term field trial in Spain

Summary: As Tall Wheatgrass, Switchgrass is a perennial grass that offers similar advantages.

Switchgrass (*Panicum virgatum* L.) is a warm season C4 grass propagated by seeds. Since the early 1990's the crop has been developed as an herbaceous energy crop for ethanol and electricity production.

In 2013 trials were carried out in Badajoz Province (South-Western Spain) under irrigation conditions. Cultivar used was Alamo. The aim of this work was to investigate the optimal dose of seeds. Two treatments were tested: 12 and 20 kg/ha, and minimum tillage conditions. The volume of water applied was 3,700 m^3 ha^{-1}.

The results showed that it is a species adapted to sandy-loam soil and acidic pH of 6.6. In Spain, irrigation was necessary in order to ensure the good establishment and high biomass yields as well.

In this case, higher doses of seeds resulted in higher productions, showing yields between 10 and 17 t.d.m. ha^{-1} y^{-1}.

The composition of the biomass was: ash content 5.1%, 46.2% C, 5.9% H, 0.53% N and Gross Calorific Value (GCV) of 18.6 MJ kg^{-1}.

4.11 PA11: About Switchgrass long-term field trial in Greece

Title: Switchgrass cultivation on marginal land in central Greece

Summary: Two Switchgrass field trials were established by seeds in 1998 on marginal land located in central Greece and are still on-going. The aim was to identify the appropriate cultural practices of Switchgrass when grown on marginal land. Tested factors were: 10 varieties in the first and 5 in three nitrogen rates (0, 75 and 150 kg N/ha) in the second. Varieties were: Caddo, Alamo, Blackwell, Cathage, Cave-in-rock, Forestburg, Kanlow, Pangburn, SL 93-2, SL 93-3, SL 94-1, SU 94-1 and Summer.
Biomass yields were maximized in the second growing period and come up to 20 t/ha (oven-dried), almost double to yields recorded at first year. In the 3rd year a yield reduction was measured from 5% to 20%. Yields reduction continued in year 4 and for more than a decade the dry matter yields varied from 12 to 14 t/ha. Further reduction was recorded from 18th till 20th year of the plantation and the mean dry yields varied from 8 to 10 t/ha during this period. During two decades lowlands varieties gave always higher yields but the superiority of lowland over upland was quite profound till the 6th growing period. Lowland varieties were higher with stronger stems and thus had higher lodging resistance than upland ones. Lodging problems were recorded for the upland varieties at the mid-point of the tested years and at the end of summer, after strong rainfall with high winds. In the first years, no significant effect of nitrogen fertilization on growth and yields was recorded. From year 6 to 20 dry yields for switchgrass varieties were always higher in the plots that received 150 kg N/ha as top fertilization. From 18th growing season the plantation began to look quite old and the tiller density had been greatly reduced. The average mean yields of switchgrass (oven-dried) fields was 12 t/ha/yr.

4.12 PA12: About Short Rotation Coppices long-term field trial in Poland

Title: Short Rotation Coppices cultivation on sandy soil with different soil enrichment method in Poland

Summary: Poplar, Willow and Black locust are Short Rotation Coppices (SRC) species. Their plantations are established mainly on poor quality marginal or contaminated soils. The aim of this research, located in North-Eastern Poland, was to determine the impact of soil enrichment method on survivability, productivity and energy value of a yield of three plant species cultivated in four-year harvest cycle on sandy soil. This sandy soil was characterized by unfavourable air and water conditions. Such conditions caused in periods of no precipitation permanent water shortage for plants. The highest average yield of dry biomass, in four-year rotation, was found for Willow, 33.36 Mg ha^{-1}. Poplar yielded 0.5 Mg ha^{-1} lower and Black Locust almost three times lower. The highest yield in the whole experiment was obtained for Poplar fertilized with lignin and mineral fertilizers (41.96 Mg ha^{-1} d.m.). A similar yield was obtained for Willow fertilized with lignin, mycorrhiza and mineral fertilizers (41.20 Mg ha^{-1} d.m.) and fertilized with lignin and mineral fertilizers (39.32 Mg ha^{-1} d.m.). The use of lignin in combination with mineral fertilizers resulted in an increase in the yield by 8-14% compared to mineral fertilizers alone for Willow and Poplar and in a nearly twofold increase for Black Locust. The energy value of the yield ranged from 28.6 to 176.7 GJ ha^{-1} year^{-1}, respectively, for Black Locust grown on the control plot and for Poplar grown on the plot with mineral fertilization and lignin used in combination. Thus, real possibilities of increasing the biomass and energy yield of SRC on sandy soils have been found, including marginal ones, by appropriate selection of woody species and soil enrichment. These results should be verified in subsequent harvesting cycles.

4.13 PA13: About Willow long-term field trial in Poland

Title: Biomass yield from Willow cultivated in 4-year harvest cycle on marginal land in Poland

Summary: In this study, the biomass yield and morphological traits of plants were reported from a field trial with six genotypes of Willow, cultivated in northern Poland. Willow was planted using a pole cutting system, which is called Eco-Salix. Two planting densities were selected: 5,200 and 7,400 plants/ha at two marginal sites. The first site had heavy textured clay soil and the second site was located on peaty muck soil. The aim of this study was to determine the morphological traits of plants and the biomass yield of six Willow genotypes (clones and varieties) under low-input agriculture on two marginal soils with a quadrennial harvest cycle. In the field trial, the average Willow biomass yield of dry matter was 7.87 Mg ha^{-1} $year^{-1}$. The new variety Ekotur had higher yield and more favourable morphological traits compared to other registered Polish varieties. The Willow biomass yield obtained on peat muck soil was significantly higher than from Willow grown on heavy textured clay soil. Eco-Salix system could be effective if used: (i) in regions of low forest coverage to increase biodiversity; (ii) on lands permanently or periodically too wet; (iii) and on land where heavy machinery cannot be used for soil preparation. The Eco-Salix system has the potential to produce high yields of Willow biomass under conditions of low-input agriculture (no or reduced tillage, and a limited number of other management practices) using poles on marginal soils. Furthermore, Ekotur (*Salix viminalis*) and cv. Doutur (*S. alba*) can be recommended for cultivation due to high biomass yield on peat-muck soil. When converting land to bioenergy production, the Eco-Salix system can be used on marginal lands and can provide additional environmental and financial benefits.

4.14 PA14: About Scots Pine long-term field trials in Latvia

Title: Scots Pine long-term field trials in Latvia

Summary: In Northern Europe Scots Pine (*Pinus sylvestris*) is one of the most often planted tree species in plantations. When planted in abandoned agricultural land and intensively tended, Pine successfully takes root in open areas. 15-year-old plantations in 7 sites were evaluated. Overall, the growth of plantation Pine is evaluated as average or good, yet it grows best in naturally dry podzolic sandy, sod-podzolic sandy loam and gravelly loam soils. When plantation is established on marginal or abandoned agricultural land, Scots Pine shows slow development in the first 5 years (on average 0.10 to 0.15 m year^{-1}). Diameter at Breast Height (DBH, 1.3 m) is reached at 6 - 8 years, and the growth of Pines increase at this age. 15-year plantation Pine on agricultural land shows the same DBH parameters that are found on forest land at 25 - 28 years and average height at 16 -18 years. The stock volume of well-growing plantation Pine may by the age of 15 be as high as 80 to 155 m^3 ha^{-1}, and by 22 years reach even 243 m^3 ha^{-1}. Pine plantations produce the highest stock volume in podzolic, cultivated, and sod-podzolic soils, where the stock volume for 15 to 16-year Pine is 112 to 155 m^3 ha^{-1}, with the current volume growth 5 to 8 m^3 ha^{-1} per year. Above ground biomass analysis show that in plantations 12 - 15-year-old tree has total biomass of 137 - 190 kg consisting of stem biomass 70 - 149 kg (51 - 78%) and crown biomass 67 - 42 kg (49 - 22%). Agricultural land can be too fertile for Scots Pine, leading to rapid growth, but also to development of thick lateral branches, which decreases wood quality and even stock volume. Therefore, it is important to prune the trees and carry out thinning no later than at 14 - 15 years of age.

4.15 PA15: About MAGIC good practices

Title: Good practices in MAGIC

Summary: Marginal lands are in large part attributed to agricultural fields which have been abandoned. This is a major problem in terms of environmental, socioeconomic and landscape implications, as it can cause several impacts, such as higher risk of fires, loss of biodiversity, water scarcity, etc., essential for the sustainable development of rural communities. The aim of identifying ‘Good Practices’ is to understand the context of using marginal land for cropping, the state and prospects for industrial crops, the conditions framing their cultivation and the supply chains as well as their operational capacities across time and development stages. The process of identifying the ‘Good Practice’ involves gathering information on successes and failures of growing industrial crops on marginal lands in different contexts and lessons learned from them followed up with analysis of what works, what does not work and why. The ‘Good Practice’ can be assessed based on a combination of technical, environmental, economic and socio-economic criteria and indicators.

It will follow practices which rehabilitate the biophysical constraints related to the soil and water conditions of the land while improving environmental, economic and societal establishments and operational aspects of the value chain. These practices will lead a path to policy success in integrating industrial crops cultivated in marginal lands in bio-based value chains. The ‘Good Practice’ when assessed will score highest on these indicators compared to other practices in the region.

5 Up-coming practice abstracts

So far, 17 additional PA's from a selection of public deliverables of the MAGIC project (see *Table 1*) are planned. The selection of the respective deliverables was made by the consortium according to the expected results and findings from the tasks that could be of interest to practitioners and farmers. However, partners involved in long-term field trials will also summarize and update their main outcomes during the lifetime of the MAGIC project. In addition, any other useful results obtained will be add in the PA format.

Table 1. List of selected deliverables for PA elaboration.

Deliverable	Title
D1.5	Handbook with fact sheets of the existing resorce-efficient industrial crops
D1.10	Final version of the MAGIC-DS available on the website
D2.1	Definition and classification of marginal land suitable for industrial crops in Europe
D2.5	Final MAP-DB
D2.6	Methodological approaches to identify and map marginal land suitable for industrial crops in Europe
D3.4	New lines of industrial crops with improved quality adapted to marginal land
D4.2	Farmers' guidelines on "How to cultivate profitable industrial crops on marginal land"
D5.1	Inventory on available harvesting technologies for industrial crops on marginal land
D5.2	High-resolution maps of potential biomass supply from marginal land around a biorefinery
D5.4	Release of the Bio2Match tool user interface and documentation
D5.6	Report on Demand-driven supply and logistics plan for industrial crops from marginal lands for existing operational biorefineries
D6.7	Report on integrated sustainability assessment
D7.1	Report with profiles of Best Practice Cases
D7.2	Report with analysis of Best Practices
D7.3	Report on key findings and transferability
D7.4	Best-Practice Guidelines
D7.5	Policy recommendations

6 Conclusions

This document gathers the fifteen practice abstracts that have been produced in the first nineteen months of the MAGIC Project. While PA1 provides an overview of the general purpose of the MAGIC Project, PA2 presents some of the factors and approaches used by the Stichting Wageningen Research to MAGIC marginal lands (Task 2.1). In addition, in PA2 the expectations for the spatially explicit map database (Task 2.4) that will be created from it, are presented.

PA3 and PA15 present some of the expected outcomes from Task 4.2 and Task 7.1, respectively. The other PA's summarize preliminary outcomes that have been obtained to this point from several long-term field trials (PA4, PA5, PA6, PA7, PA8, PA9, PA10, PA11, PA12, PA13 & PA14).

Although not so many results are currently available, the present PA's are intended to present preliminary and potential results and provide an overview of the expected benefits for practitioners. As the project progresses, more practices abstracts will be released based on other public deliverables, long-term field trials or any other useful outcomes.

This deliverable is linked with Tasks 8.3 (EIP and Operational Groups interaction) and 8.4 (Multi-Actor networking) from WP8.

In line with Task 8.3, MAGIC will take advantage of the seat on the EIP-AGRI subgroup of innovation (through Spanish Cooperatives-COGECA) and foster the interaction with it. Contacts with the EIP-Service point staff have been held to arrange collaboration as closest as possible, including feeding the newsletter and webpage of EIP-AGRI with easily understandable practical knowledge for broad dissemination in the common EIP format, such us the practice abstracts presented in this document. In this sense, the leader of the MAGIC Project (CRES) will send these PA in the Common Format template (see Annex B) to the EIP-AGRI staff, whom are expected to upload those to their website just after it.

Regarding Task 8.4, MAGIC will periodically report its findings to COPA-COGECA, through their Sectorial Boards of European farmers (Oilseeds & Protein Crops WG, Cereals WG, Environment WG, BioEnergy WG, and Rural Development WG). In this sense, several attendances to these boards will be held along the life of the MAGIC project. PA's will be used as supporting material to report on the advances of the project and collect their comments, suggestions and doubts.

7 References

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CENTRO DE INVESTIGACIONES ENERGÉTICAS, MEDIOAMBIENTALES Y TECNOLÓGICAS – CIEMAT, 2018. *PA9: About Tall Wheatgrass long-term field trial in Spain.*

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EIP-AGRI Agricultural and Innovation. EIP-AGRI common format

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UNIVERSITA DEGLI STUDI DI CATANIA – UNICT, 2018. *PA6: About wild sugar cane long-term field trial in Italy*.

UNIVERSITA DEGLI STUDI DI CATANIA – UNICT, 2018. *PA7: About arundo and miscanthus long-term field trials in Italy.*

UNIVERSITAET HOHENHEIM – UHOH, 2018. *PA3: About MAGIC long-term field trials*.

UNIVERSITAET HOHENHEIM – UHOH, 2018. *PA4: About miscanthus long-term field trial in Germany.*

8 Annexes

Annex A: An example of a practice abstract published at the EIP-AGRI website

Practice summary

Practice abstract 1

Short summary for practitioners (in English):

The Operational Manual that will be derived from the project will reflect both the normative constraints (European and Regional) as well as the economic and technical needs that the transition to OF entails in 8 different productive orientations.
The benefits expected for organic farmers will be derived from a positive impact on productivity by setting clear guidelines to make the farms more profitable. For companies, to ensure their supply of organic raw materials for both fresh marketing and processing. For society, the information collected will serve as a stimulus for conventional farmers that want to transform their operation to OF.
Other important expected result is a minimum increase of 18% the number of farmers and livestock growers registered as organic producers, since previous analyzes have shown that this number of applicants for OF registration discard after application, either because of lack of general Information, or lack of advice on technical issues, so that this operational group may be the opportunity for producers to save barriers and facilitate their incorporation to OF.
The first versions of the Basic Operational Manual are now available to producers and implementation is in practice, and the permanent network of specialized advisory services in OF is being set up in the Basque Country. It is hoped that knowledge will reach more producers interested in OF. Registration figures provided by ENEEK are increasing in the whole Basque Country. These actions are expected to increase the area of organic production from 1.1 to 2.2% of the Usable Agrarian Area (UAA) increasing the number of producers from almost 400 to 600 and the number of processors from more than 120 to 200 in the next two years.

Annex B: First version of the H2020 EIP excel template to be submitted to EIP-AGRI for MAGIC Project

Project Information

Project identifier (see INSTRUCTIONS)	2017H2020_727698_MAGIC
Title of the project in native language (*can be the language of the coordinator / one of the partners - otherwise repeat the title in English*)	MAGIC - Marginal Lands for Growing Industrial Crops. Turning a Burden into an Opportunity
Title of the project in English (*provide the project ACRONYM + short title within the characters limit*)	MAGIC - Marginal Lands for Growing Industrial Crops. Turning a Burden into an Opportunity

Geographical location

Country (*of the coordinator*)	Greece
Main geographical location (NUTS3) (of coordinator - *for geolocalisation on map*)	EL305 - Eastern Attica
Editor of the text: person/organisation responsible for delivering the text	Efthymia Alexopoulou - CRES

Project coordinator (lead-partner) according to the cooperation/consortium agreement:

Name	Center for Renewable Energy Sources and Saving - CRES
Address	Biomass Department of CRES Center for Renewable Energy Sources and Saving 19th Km Marathonos Avenue 19009 Pikermi Attikis
E-mail	ealex@cres.gr
Telephone	+30 210 6603300

Project period:

start year (YYYY)	2017
end year (YYYY)	2021
Project status: ongoing (after selection of the project) or completed (after final payment)	Ongoing
Main **funding source** (Rural development programme, H2020, or other EU, national/regional or private funds)	H2020
Total budget of the project (total costs - in euros)	5,999,987.00

Objective of the project <u>in English</u>: what problems/opportunities does the project address that are relevant for the practitioner/end-user, and how will they be solved? - (300-600 characters, word count – no spaces)	Due to changing climatic conditions in Europe, the areas that are less favourable for conventional agriculture are expanding. This land has been either abandoned because of its productivity, or it is used as grassland. Moreover, contaminated soils cannot be used for food or feed production for sanitary reasons and thus provide great potential for the production of biomass for material or energy use. Cultivating industrial crops on marginal land unsuitable for food production is consistently proposed as a viable alternative to minimize land-use competition for food production, and its adverse effects (direct or indirect) on food security, land-based greenhouse gas emissions and biodiversity loss.
Description of project activities <u>in English</u>: (max 600 characters, word count – no spaces): short summary highlighting main project activities.	MAGIC is an up-to-date database that combines two different data sets (MAGIC CROPS and MAGIC MAPS) into a Decision Support System (DSS). MAGIC CROPS categorize resource-efficient industrial crops according to their agronomic characteristics: input requirements, yield performance and quality traits for end-user applications. MAGIC MAPS chart and analyse marginal land in Europe that are exposed to natural constraints. These classifications serve as a basis for the development of best-practice options for industrial crops. Moreover, the DSS gives farmers a quick and easy overview of the most productive industrial crops that meets the geological requirements of their soils.
Additional comments (<u>in English</u>): free text field which can be used by the editor e.g. for listing facilitating elements or obstacles for the implementation of the produced results, for suggestions for future actions/research, for messages to end-users etc.	Industrial crops can be broadly categorised as: -Oil, -Lignocellulosic, -Carbonhydrate, - Speciality Crops

Project partners (mandatory information) - *N.B. : "Name" can be that of an organisation - "Address" should include the country*					
	Name	**Address**	**E-mail**	**Telephone**	**Type of partner**
project coordinator (lead partner) *from PROJECT INFORMATION*	Center for Renewable Energy Sources and Saving - CRES				Research institute
project partner	UNIBO				Research institute
project partner	WR				Research institute
project partner	WU				Research institute
project partner	UNHO				Research institute
project partner	INRA				Research institute
project partner	IFEU				Research institute
project partner	Imperial College				Research institute
project partner	Nova-Institut GmbH				SME
project partner	UNICT				Research institute
project partner	FCT/UNL				Research institute
project partner	ARKEMA				Other
project partner	CIEMAT				Research institute
project partner	Spanish Co-ops				SME
project partner	3B				SME
project partner	CREA				Research institute
project partner	IWNiRZ				Research institute
project partner	AUA				Research institute
project partner	IBCSB NAASU				Research institute
project partner	LSFRI SILAVA				Research institute
project partner	IIASA				Research institute
project partner	SAS Novabiom				SME
project partner	VDS				SME
project partner	BIOS				SME
project partner	BTG				SME

Keyword - category

Keyword - category 1	Agricultural production system
Keyword - category 2	Plant production and horticulture
Keyword - category 3	Soil management / functionality
Keyword - category 4	Farming/forestry competitiveness and diversification
Keyword - category 5	
Keyword - category 6	
Keyword - category 7	
Keyword - category 8	
Keyword - category 9	
Keyword - category 10	

Audiovisual material which is useful and attractive for practitioners (e.g. YouTube link, videos, other dissemination material)

Title/description (in English)	**URL**
MAGIC Project Website	http://magic-h2020.eu/
Leaflet & poster	http://magic-h2020.eu/press-publications/
Documents & reports	http://magic-h2020.eu/documents-reports/
First press release	http://magic-h2020.eu/press/

Official website of the project

Title/description	**URL**
MAGIC - Marginal Lands for Growing Industrial Crops	http://magic-h2020.eu

Links to other website(s) hosting information on the project (results) that are available after the project has ended, by preference using the existing local/regional/national communication channels that practitioners most often use.

Title/description	**URL**
	http://

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 1:

Short title in English	Marginal lands for growing industrial crops
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Marginal lands for Growing Industrial Crops (MAGIC) is a 4-year project and gets funding by the European Commission. The project aims to promote the sustainable development of resource-efficient and economically profitable industrial crops grown on marginal lands. Industrial crops can provide abundant renewable biomass feedstocks for the production of high added-value bio-based commodities (such as bio-plastics, bio-lubricants, bio-chemicals, pharmaceuticals, bio-composites, etc.) and bioenergy. Most of these crops are multi-purpose and offer the opportunity to follow a cascade biorefinery concept to produce a number of high-quality bio-products and bioenergy, to strengthen the bio-based economy. To achieve the project objectives, an up-to-date database of existing resource-efficient industrial crops will be developed with information on their agronomic characteristics, input requirements, yield performance and quality traits for end use applications. In parallel, current and future marginal lands in Europe facing natural constraints will be mapped, characterised and analysed to provide a spatially explicit classification that will serve as a basis for developing sustainable best-practice options for industrial crops. A Decision Support System (DSS) based on both MAGIC-CROPS and MAGIC-MAPS will be developed and validated with the active involvement of farmers and end users in order to choose the most promising industrial crop at any geo-location in Europe. In the long term, this strategy will foster the sustainable development of the EU bio-based economy and will contribute to achieving EU energy and climate targets.

Practice "abstract" 2:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Mapping marginal lands for growing industrial crops
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The purpose of the MAGIC mapping is to characterize and analyse projections for current and future marginal lands in Europe facing natural constraints. Identified MAGIC marginal lands are defined as: "Lands having limitations which in aggregate are severe for sustained application of a given use and/or are sensitive to land degradation, as a result of inappropriate human use, and/or have lost already part or all of their productive capacity as a result of inappropriate human use". The elements that were considered in building the classification include biophysical limitations clustered in six main groups. In addition, the resulting marginal land map was further classified according to, land use management, socio-economic limitations, ecosystem services and drives and pressures influencing the ecosystem functions. As a result, in total 29% of the agricultural land (i.e. land classified as agricultural by Corine Land Cover since 1992) in the European Union are classified as marginal. The most common limitations are rooting limitations, with 12% of the agricultural area. This is followed by adverse climate and excessive soil moisture occurring in respectively 11% and 8% of the agricultural land. The spatial explicit classification created by MAGIC will serve as a basis for developing sustainable best-practice options for industrial crops in Europe. In addition, the spatially explicit map database is accessible via the project website and will be maintained and further improved during the project's lifetime and at least five years beyond the project completion. Visitors to the public website can access the map to inform themselves about the marginal land status in their region but can also help to evaluate the quality of the map.

Practice "abstract" 3:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Long-term field trials with industrial crops on marginal land
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	One of the expected results of the MAGIC Project will be a comprehensive overview of the long-term performance potential of industrial crop cultivation on marginal land in Europe. For this purpose, the results of several long-term field trials with important industrial plants such as Miscanthus, Giant Reed, Reed Canary Grass, Camelina, Hemp and Poplar, which are carried out Europe-wide under the most important marginal growth conditions such as adverse rooting conditions, adverse climatic conditions and unfavourable terrain, will be compiled and evaluated. Many of these field trials are still on-going. In particular, the best low-input agricultural cultivation strategies for the crop categories ‘tillage’, ‘nitrogen fertilization’, ‘weed control’ and ‘irrigation’ will be identified. Practitioners should benefit from the results by implementing low-input agricultural practices for industrial crop cultivation, which are adapted to both the marginality conditions of their locations and to the market requirements in their region. It is assumed that this will increase both the overall income of the farms and the net profit due to higher biomass yields (and qualities) and higher production efficiencies. In addition, to these direct benefits, it is expected to bring indirect benefits through improved legal frameworks resulting from the policy recommendations.

Practice "abstract" 4:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Miscanthus cultivation on marginal land in southwest Germany
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: – Main **results/outcomes** of the activity (expected or final) – The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In 2012 and 2014, several field trials with Miscanthus (a perennial C4 grass for combustion and other conversion routes) were carried out at various marginal sites in southwest Germany. The most severe marginality conditions at one of these sites ('OLI') are a combination of adverse root conditions (shallow soil (10 - 20 cm) and stoniness (50%)) and low temperatures (frost and short vegetation period). At OLI, six genotypes of Miscanthus were established in 2014 (~1 plantlet/m²). Weeding was performed by hand in 2014 and 2015. The harvest was carried out each year in spring starting from 2016. No fertilization was applied. The previous crop was grassland. The estimated accumulated dry matter yields of the first three growing seasons (2015, 2016 and 2017) range between 12.4 t/ha (GNT 4) and 30.9 t/ha (Miscanthus × giganteus). These preliminary results suggest that low-input cultivation of Miscanthus on shallow stony soil under low temperature conditions may be a success depending on the genotype. Miscanthus × giganteus is expected to provide high dry matter yields (in relation to the given marginal growing conditions) also in the following seasons. The expected main recommendation of these results is that farmers should consider the possibility of growing Miscanthus × giganteus on marginal areas similar to those of OLI (shallow stony soil + low temperature). In addition to economic benefits such as high biomass yields, low external inputs (fertilizers, pesticides) and low labour intensities (except for the establishment procedure), there are a number of eco-systemic advantages of Miscanthus × giganteus over annual cultivation systems such as improved soil fertility, habitat networking and reduced soil erosion.

Practice "abstract" 5:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Ukrainian practice of growing Miscanthus and Energy Willow on marginal land
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Soils studied at the Ukrainian case present two main marginality factors; unfavourable soil structure (hard clay) and poor chemical properties (acidity, low organic matter). Growing Willow on a hard clay soil (≥50% clay) can result in good productivity, however, it requires additional agronomical practices. Thus, ripping of interspace improves agro-physical properties of the soil while the treatment of cuttings with humic products and micronutrients facilitates their rooting and adaptation to the specific conditions of growing. Application of mineral fertilizers is not necessary on such soils, as their natural productivity in Ukraine is rather high. Growing Willow on hard clay soils without plant adaptation measures leads to a small annual height increment and low productivity of plantation. Energy Willow produces large volumes of dry biomass starting from the 3rd year of growing. When harvested every two years, willow reveals its full potential on the 4th year of growing. When growing Miscanthus on acid soils, minimum amount of nutrients is required, for example, neutral mineral fertilizers N40P40K40. The maximum plantation productivity may be gained on the 4th year of growing. Productivity of energy crops for growing on soils with low content of organic matter largely depends on the type and amount of fertilizers applied. Therefore, fertilization must be performed considering the actual nutrients removal with harvest. Growing Miscanthus in this kind of soils during seven years allows to increase organic matter content in ploughed soil layer by 0.37%. Planting depth (8, 12 and 16 cm) had insignificant effect on increasing winter hardness of Miscanthus and its green and dry biomass yield on the 2nd and 3rd years of growing.

Practice "abstract" 6:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Wild Sugar Cane on marginal lands affected by drought in southern Italy
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Mediterranean climates are characterized by long periods of drought during summer and short dry periods from autumn to spring, what limits plant CO2 assimilation and biomass production to a great extent. More limiting scenarios are forecasted due to climate change in the coming years in the Mediterranean basin. Under these circumstances, plants with excellent adaptation are needed. Perennial crops, and grasses in particular, have proved to be more efficient than annual crops for biomass production for several environmental and economic reasons. The Joint Research Centre (JRC) has set thresholds to define marginal lands in terms of biophysical constraints. In this case, climate limitation given by the ratio between precipitations and potential evapotranspiration (P/ET) was focused. Areas with P/ET ≤0.60 are classified as affected by dryness. The study follows up a long-term plantation of the C4 perennial grass wild sugarcane (Saccharum spontaneum ssp. aegypticum) under different water regimes in a semi-arid environment. The species were established at the experimental farm of the University of Catania in 2005 by using rhizome cuttings. Biomass dry matter yield was significantly affected by irrigation treatment and meteorological conditions of the growing season (mainly precipitation amount and distribution) with yield values ranging between 29.9 and 37.1 Mg ha-1 in full-irrigation, between 24.5 and 32.0 Mg ha-1 in half-irrigation and between 19.1 and 27.4 Mg ha-1 in rainfed conditions. Wild Sugar Cane is well adapted to environments dominated by dryness, and even after 10 years the biomass yield remain quite stable and at very high levels. However, agronomic, energetic, environmental and economic issues need further research.

Practice "abstract" 7:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Arundo and Miscanthus on marginal land affected by dryness in fertilized and unfertilized conditions in southern Italy
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Perennial, non-food grasses have been proposed as the most efficient species for biomass production due to their agronomic, environmental and social benefits. Species characterized by high water use efficiency and low nitrogen requirement, well adapted to use natural resources of a specific environment, can be recommended as ideal crops. Along with irrigation and water savings, nitrogen requirement is a significant issue in intensive agriculture and has a great effect over the energetic balance of crops. Therefore, low input cropping systems could directly mitigate greenhouse gas emissions. In this case long-term plantations of two perennial grasses (Arundo donax and Miscanthus x giganteus), grown in rainfed conditions under two nitrogen regimes, were compared in an environment affected by dryness (according to the thresholds set by the Joint Research Centre (JRC) in terms of ratio between precipitations and potential evapotranspiration (P/ET ≤0.60)). Miscanthus x giganteus and Arundo donax were transplanted in summer 1993 and in spring 1997, respectively. In 2015 (22-year for Miscanthus and 18-year for Arundo), Arundo and Miscanthus (fertilized with 80 kg N ha-1) showed similar yields (11.9 and 10.4 Mg DM ha-1), while Arundo unfertilized (N0) produced 10 Mg DM ha-1 against 5.3 Mg DM ha-1 of Miscanthus N0. In 2016 (23-year for Miscanthus and 19-year for Arundo) Arundo and Miscanthus N0 produced 10.6 and 6.2 Mg DM ha-1, while Arundo and Miscanthus N80 attained 15.3 and 8.7 Mg DM ha-1. In 2017 (24-year for Miscanthus and 20-year for Arundo) a similar trend was observed, Arundo N80 showed the highest yield (14.9 Mg DM ha-1) followed by Miscanthus N80 (9.7 Mg DM ha-1), Arundo N0 (8.4 Mg DM ha-1) and Miscanthus N0 (5.9 Mg DM ha-1).

Practice "abstract" 8:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Siberian Elm long-term field trial in Spain
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Siberian Elm (Ulmus pumila L.) is a hardy and fast-growing tree that features greater resistance to Dutch Elm disease than other species in genus Ulmus. Drought tolerance, adaptation to different environments and sprouting capacity suggest that this plant species could be grown as a short rotation energy/industrial crop. Siberian Elm was planted in 2 plots in 2009 and 2010 in marginal land in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2009, two plant densities (3,333 and 6,666 plants ha-1) under two irrigation regimes (2,000 and 4,000 m3 ha-1 y-1) were implemented and one plant density was established in rainfed conditions in 2010. Furthermore, 2 crops cycles were studied in each plot. The results for a nine years period confirmed that Siberian Elm is a fast-growing woody species, adapted to the harsh climate of Soria: cold winters, frosts, and wind. It is also resistant to pests and diseases since no pesticide treatment has been carried out. Siberian Elm prefers well-drained soils, although it also tolerates a wide variety of adverse conditions, such as soils with low organic matter content and flooding situations. Yield was strongly influenced by the amount of irrigation water applied, planting densities and crop cycle. Maximum yields were obtained with planting densities of 6,666 and 3,333 trees/ha cropped every 3 and 4 years, respectively. The yield ranged between 4 - 7.5 t.d.m. ha-1 y-1. The composition of the biomass was: ash content 3.0%, 48.0% C, 6.0% H, 0.5% N and Gross Calorific Value (GCV) of 19.2 MJ.kg-1.

Practice "abstract" 9:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Tall Wheatgrass long-term field trial in Spain
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Perennial grasses have been envisaged by the scientific community as an interesting group of plant species for the sustainable production of biomass in marginal land in terms of crop diversification, improved control of soil erosion and recovery of soil organic matter content. Compared with annual grain crops, perennial biomass crops require fewer inputs, produce more energy and reduce Greenhouse Gas (GHG) emissions than annual cropping systems. In 2010 and 2013, field trials with Tall Wheatgrass were carried out in two marginal lands in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2010 Elytrigia elongata Alkar was studied as single crop, and mixed with other annual and perennial species. In 2013 three Elytrigia elongata cultivars: Alkar, Szarvasi-1 and Bamar were established on a parcel. The results obtained in an eight years period showed that Tall Wheatgrass is a species well adapted to the hard climate conditions of Soria with a high tolerance to drought. Moreover, it is a crop resistant to pests and diseases since no pesticide treatment has been carried out. Tall Wheatgrass prefers well-drained soils, although it tolerates a wide variety of adverse conditions, such as soils with low organic matter content and moderate salinity. However, flooding situations should be avoided. Yields were between 2 and 5 t.d.m. ha-1 y-1. Elytrigia elongata Alkar produced the most yield when planted as single crop. Elytrigia elongata Szarvasi-1 produced the most yield. The composition of the biomass was: ash content 5.2%, 46.0% C, 6.1% H, 0.6% N and Gross Calorific Value (GCV) of 18.5 MJ.kg-1.

Practice "abstract" 10:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Switchgrass long-term field trial in Spain
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	As Tall Wheatgrass, Switchgrass is a perennial grass that offers similar advantages. Switchgrass (Panicum virgatum L.) is a warm season C4 grass propagated by seeds. Since the early 1990's the crop has been developed as an herbaceous energy crop for ethanol and electricity production. In 2013 trials were carried out in Badajoz Province (South-Western Spain) under irrigation conditions. Cultivar used was Alamo. The aim of this work was to investigate the optimal dose of seeds. Two treatments were tested: 12 and 20 kg/ha, and minimum tillage conditions. The volume of water applied was 3,700 m3 ha-1. The results showed that it is a species adapted to sandy-loam soil and acidic pH of 6.6. In Spain, irrigation was necessary in order to ensure the good establishment and high biomass yields as well. In this case, higher doses of seeds resulted in higher productions, showing yields between 10 and 17 t.d.m. ha-1 y-1. The composition of the biomass was: ash content 5.1%, 46.2% C, 5.9% H, 0.53% N and Gross Calorific Value (GCV) of 18.6 MJ kg-1.

Practice "abstract" 11:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Switchgrass cultivation on marginal land in central Greece
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Two Switchgrass field trials were established by seeds in 1998 on marginal land located in central Greece and are still on-going. The aim was to identify the appropriate cultural practices of Switchgrass when grown on marginal land. Tested factors were: 10 varieties in the first and 5 in three nitrogen rates (0, 75 and 150 kg N/ha) in the second. Varieties were: Caddo, Alamo, Blackwell, Cathage, Cave-in-rock, Forestburg, Kanlow, Pangburn, SL 93-2, SL 93-3, SL 94-1, SU 94-1 and Summer. Biomass yields were maximized in the second growing period and come up to 20 t/ha (oven-dried), almost double to yields recorded at first year. In the 3rd year a yield reduction was measured from 5% to 20%. Yields reduction continued in year 4 and for more than a decade the dry matter yields varied from 12 to 14 t/ha. Further reduction was recorded from 18th till 20th year of the plantation and the mean dry yields varied from 8 to 10 t/ha during this period. During two decades lowlands varieties gave always higher yields but the superiority of lowland over upland was quite profound till the 6th growing period. Lowland varieties were higher with stronger stems and thus had higher lodging resistance than upland ones. Lodging problems were recorded for the upland varieties at the mid-point of the tested years and at the end of summer, after strong rainfall with high winds. In the first years, no significant effect of nitrogen fertilization on growth and yields was recorded. From year 6 to 20 dry yields for switchgrass varieties were always higher in the plots that received 150 kg N/ha as top fertilization. From 18th growing season the plantation began to look quite old and the tiller density had been greatly reduced. The average mean yields of switchgrass (oven-dried) fields was 12 t/ha/yr.

Practice "abstract" 12:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Short Rotation Coppices cultivation on sandy soil with different soil enrichment method in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Poplar, Willow and Black locust are Short Rotation Coppices (SRC) species. Their plantations are established mainly on poor quality marginal or contaminated soils. The aim of this research, located in North-Eastern Poland, was to determine the impact of soil enrichment method on survivability, productivity and energy value of a yield of three plant species cultivated in four-year harvest cycle on sandy soil. This sandy soil was characterized by unfavourable air and water conditions. Such conditions caused in periods of no precipitation permanent water shortage for plants. The highest average yield of dry biomass, in four-year rotation, was found for Willow, 33.36 Mg ha-1. Poplar yielded 0.5 Mg ha-1 lower and Black Locust almost three times lower. The highest yield in the whole experiment was obtained for Poplar fertilized with lignin and mineral fertilizers (41.96 Mg ha-1 d.m.). A similar yield was obtained for Willow fertilized with lignin, mycorrhiza and mineral fertilizers (41.20 Mg ha-1 d.m.) and fertilized with lignin and mineral fertilizers (39.32 Mg ha-1 d.m.). The use of lignin in combination with mineral fertilizers resulted in an increase in the yield by 8-14% compared to mineral fertilizers alone for Willow and Poplar and in a nearly twofold increase for Black Locust. The energy value of the yield ranged from 28.6 to 176.7 GJ ha-1 year-1, respectively, for Black Locust grown on the control plot and for Poplar grown on the plot with mineral fertilization and lignin used in combination. Thus, real possibilities of increasing the biomass and energy yield of SRC on sandy soils have been found, including marginal ones, by appropriate selection of woody species and soil enrichment. These results should be verified in subsequent harvesting cycles.

Practice "abstract" 13:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Biomass yield from Willow cultivated in 4-year harvest cycle on marginal land in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In this study, the biomass yield and morphological traits of plants were reported from a field trial with six genotypes of Willow, cultivated in northern Poland. Willow was planted using a pole cutting system, which is called Eco-Salix. Two planting densities were selected: 5,200 and 7,400 plants/ha at two marginal sites. The first site had heavy textured clay soil and the second site was located on peaty muck soil. The aim of this study was to determine the morphological traits of plants and the biomass yield of six Willow genotypes (clones and varieties) under low-input agriculture on two marginal soils with a quadrennial harvest cycle. In the field trial, the average Willow biomass yield of dry matter was 7.87 Mg ha-1 year-1. The new variety Ekotur had higher yield and more favourable morphological traits compared to other registered Polish varieties. The Willow biomass yield obtained on peat muck soil was significantly higher than from Willow grown on heavy textured clay soil. Eco-Salix system could be effective if used: (i) in regions of low forest coverage to increase biodiversity; (ii) on lands permanently or periodically too wet; (iii) and on land where heavy machinery cannot be used for soil preparation. The Eco-Salix system has the potential to produce high yields of Willow biomass under conditions of low-input agriculture (no or reduced tillage, and a limited number of other management practices) using poles on marginal soils. Furthermore, Ekotur (Salix viminalis) and cv. Doutur (S. alba) can be recommended for cultivation due to high biomass yield on peat-muck soil. When converting land to bioenergy production, the Eco-Salix system can be used on marginal lands and can provide additional environmental and financial benefits.

Practice "abstract" 14:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Scots Pine long-term field trials in Latvia
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In Northern Europe Scots Pine (Pinus sylvestris) is one of the most often planted tree species in plantations. When planted in abandoned agricultural land and intensively tended, Pine successfully takes root in open areas. 15-year-old plantations in 7 sites were evaluated. Overall, the growth of plantation Pine is evaluated as average or good, yet it grows best in naturally dry podzolic sandy, sod-podzolic sandy loam and gravelly loam soils. When plantation is established on marginal or abandoned agricultural land, Scots Pine shows slow development in the first 5 years (on average 0.10 to 0.15 m year–1). Diameter at Breast Height (DBH, 1.3 m) is reached at 6 - 8 years, and the growth of Pines increase at this age. 15-year plantation Pine on agricultural land shows the same DBH parameters that are found on forest land at 25 - 28 years and average height at 16 -18 years. The stock volume of well-growing plantation Pine may by the age of 15 be as high as 80 to 155 m3 ha–1, and by 22 years reach even 243 m3 ha–1. Pine plantations produce the highest stock volume in podzolic, cultivated, and sod-podzolic soils, where the stock volume for 15 to 16-year Pine is 112 to 155 m3 ha–1, with the current volume growth 5 to 8 m3 ha–1 per year. Above ground biomass analysis show that in plantations 12 - 15-year-old tree has total biomass of 137 - 190 kg consisting of stem biomass 70 - 149 kg (51 - 78%) and crown biomass 67 - 42 kg (49 - 22%). Agricultural land can be too fertile for Scots Pine, leading to rapid growth, but also to development of thick lateral branches, which decreases wood quality and even stock volume. Therefore, it is important to prune the trees and carry out thinning no later than at 14 - 15 years of age.

Practice "abstract" 15:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Good practices in MAGIC
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Marginal lands are in large part attributed to agricultural fields which have been abandoned. This is a major problem in terms of environmental, socioeconomic and landscape implications, as it can cause several impacts, such as higher risk of fires, loss of biodiversity, water scarcity, etc., essential for the sustainable development of rural communities. The aim of identifying 'Good Practices' is to understand the context of using marginal land for cropping, the state and prospects for industrial crops, the conditions framing their cultivation and the supply chains as well as their operational capacities across time and development stages. The process of identifying the 'Good Practice' involves gathering information on successes and failures of growing industrial crops on marginal lands in different contexts and lessons learned from them followed up with analysis of what works, what does not work and why. The 'Good Practice' can be assessed based on a combination of technical, environmental, economic and socio-economic criteria and indicators. It will follow practices which rehabilitate the biophysical constraints related to the soil and water conditions of the land while improving environmental, economic and societal establishments and operational aspects of the value chain. These practices will lead a path to policy success in integrating industrial crops cultivated in marginal lands in bio-based value chains. The 'Good Practice' when assessed will score highest on these indicators compared to other practices in the region.